Adapting Western Forests to Climate Change and Wildfires

Susan Prichard, Keala Hagmann, and Paul Hessburg

CALFIRE Webinar

September 9, 2022

LAND ACKNOWLEDGEMENT

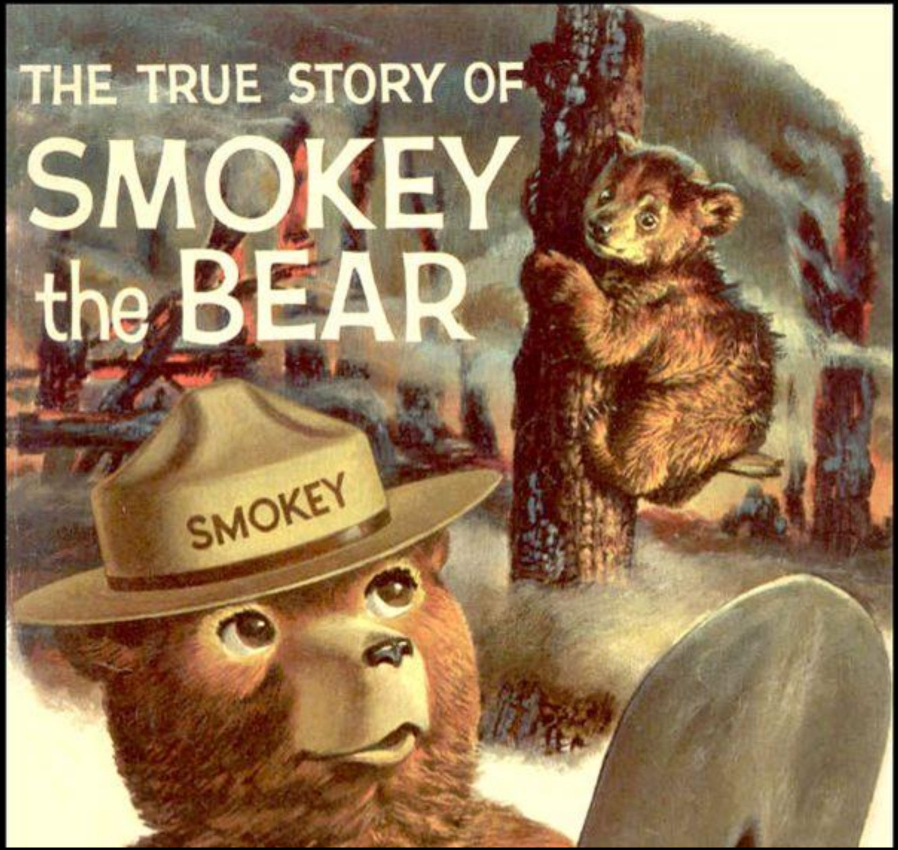
As part of the University of Washington, we respectfully acknowledge the Coast Salish peoples of this land, the land which touches the shared waters of all tribes and bands within the Duwamish, Puyallup, Suquamish, Tulalip and Muckleshoot Nations.

We respectfully acknowledge the Methow People who have lived and cared for the Methow Valley for thousands of years. I recognize that we can and must do more to build better relationships, support their voices, and acknowledge our past.

Legacies of Fire Exclusion

Megafires

2014 Carlton Complex, Upper Finley Canyon

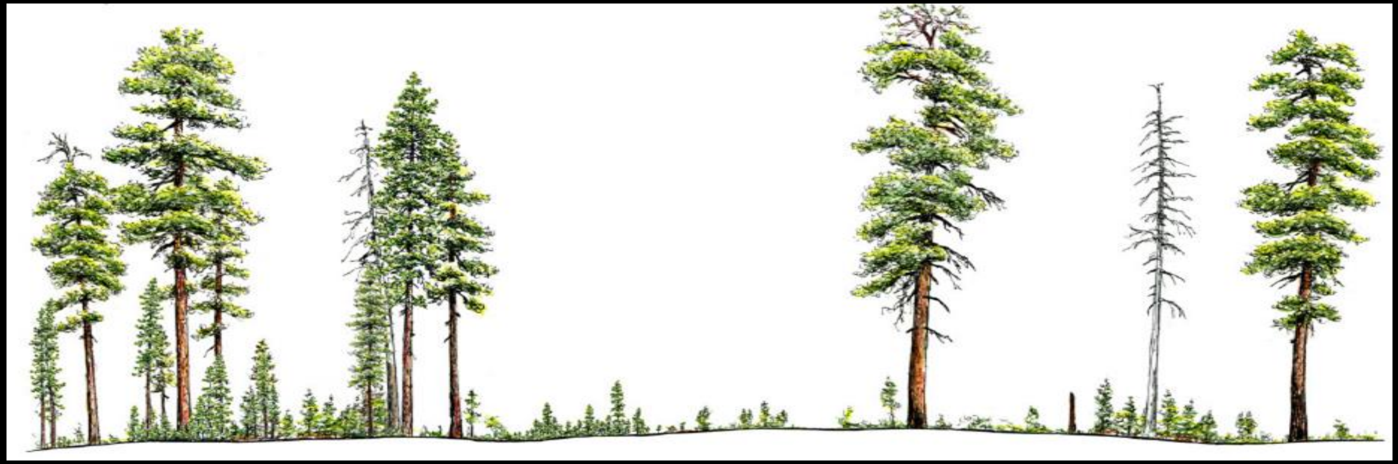


LEGACY OF FIRE SUPPRESSION?

Agents of Change

- Colonialism – curtailment of Indigenous burning
- Fire suppression policies
- Livestock grazing
- Road and rail construction
- High-grade logging
- Climate change

Fire Exclusion – patch dynamics



Fire-maintained forest with a low to moderate severity fire regime

Fire-excluded forest now vulnerable to high-severity fire events

Slide courtesy of Paul Hessburg – drawings by Bob Van Pelt

Fire Exclusion - landscape dynamics

INSIGHTS

PERSPECTIVES

ENVIRONMENTAL SCIENCE

Reform forest fire management

Agency incentives undermine policy effectiveness

By **M. P. North,**[1,2*] **S. L. Stephens,**[3] **B. M. Collins,**[1,3] **J. K. Agee,**[4] **G. Aplet,**[5] **J. F. Franklin,**[4], **P. Z. Fulé**[6]

(NCWFMS) (*6*) and the U.S. Forest Service's (USFS's) current effort to revise national forest (NF) plans provide openings to in-

Many severe wildfires are due to past fire suppression. Firefighters during the Rim Fire near Yosemite National Park, California, 25 August 2013.

Our land was taken. But we still hold the knowledge of how to stop mega-fires

Bill Tripp

The solution to the devastating west coast wildfires is to burn like our Indigenous ancestors have for millennia

▲ Flames and smoke from the Bobcat fire in Arcadia, California. Photograph: Patrick T Fallon/Reuters

As wildfires rage across California, it saddens me that Indigenous peoples' millennia-long practice of cultural burning has been ignored in favor of fire suppression.

Opinion

Using Wildfires as an Excuse to Plunder Forests

Logging won't end the blazes that are sweeping the West.

By Chad T. Hanson and Michael Brune

Dr. Hanson is an ecologist whose research focuses on forest and fire ecology. Mr. Brune is the executive director of the Sierra Club.

Sept. 4, 2018

Anders Nilsen

http://web-static-aws.seas.harvard.edu/climate/eli/Courses/global-change-debates/Sources/Forest-fires/more/North-etal-2015-short-perspective.pdf

https://www.theguardian.com/commentisfree/2020/sep/16/california-wildfires-cultural-burns-indigenous-people

https://www.nytimes.com/2018/09/04/opinion/california-wildfires-logging-farm-bill.html

National Cohesive Wildland Fire Management Strategy

fire MDPI

Article

We're Not Doing Enough Prescribed Fire in the Western United States to Mitigate Wildfire Risk

Crystal A. Kolden

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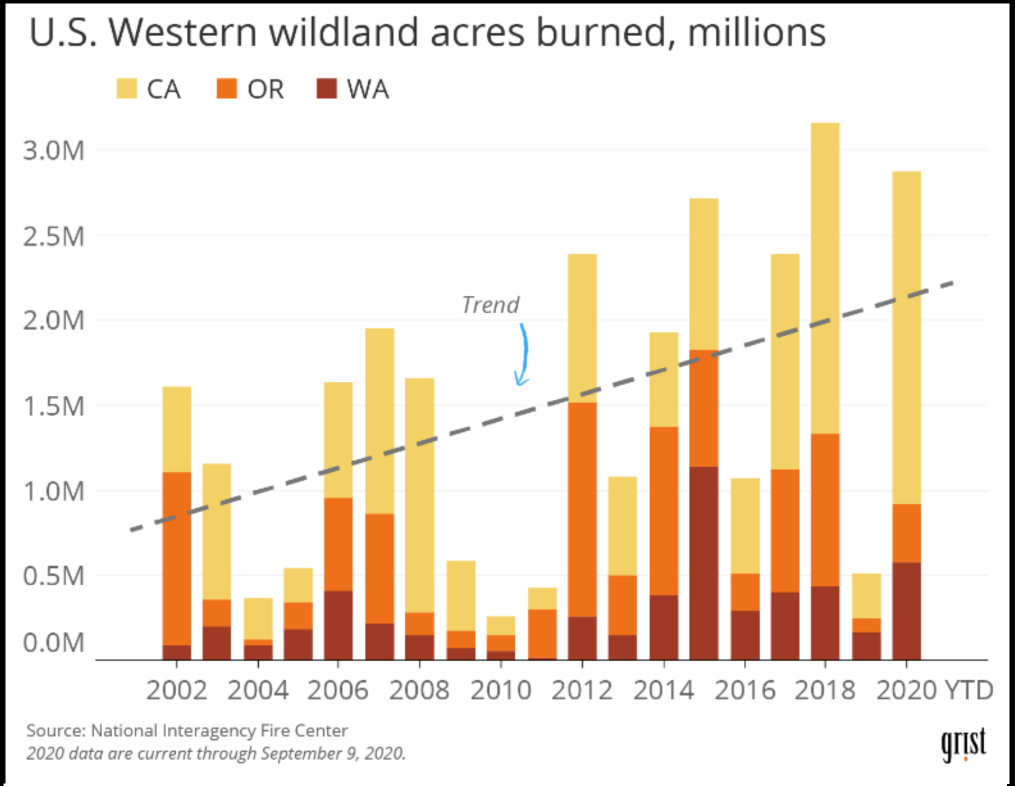
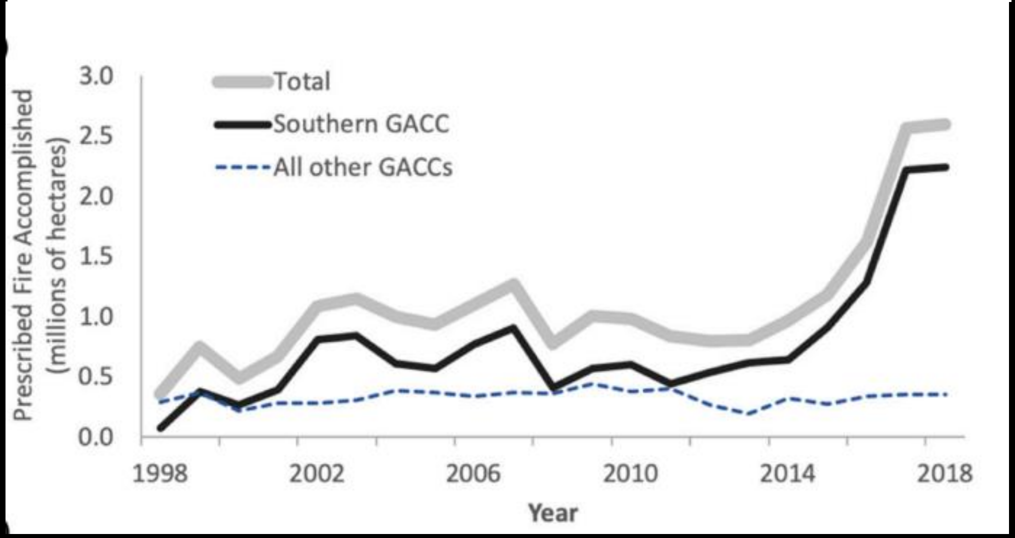




The pace and scale of restoration is not keeping up with western wildfires

The New York Times
@nytimes

In Opinion

"The truth is that logging activities tend to increase, not decrease, extreme fires," write Chad Hanson and Michael Dorsey.

The New York Times

Opinion | The Case Against Commercial Logging in Wildfire-Prone Forests

nytimes.com

Los Angeles Times

CALIFORNIA

Logging project in Yosemite National Park halted after environmental lawsuit

Stumps left from cut trees are seen in Yosemite National Park in July 2021. The nonprofit Earth Island Institute has filed a lawsuit to stop logging in the park, arguing that the "biomass removal and thinning" project violates federal environmental requirements.
(Carolyn Cole / Los Angeles Times)

10 Common Questions

1) Are the effects of fire exclusion overstated? If so, are treatments unwarranted and even counterproductive?

2) Is forest thinning alone sufficient to mitigate wildfire hazard?

3) Can forest thinning and prescribed burning solve the problem?

4) Should active forest management, including forest thinning, be concentrated in the wildland urban interface (WUI)?

5) Can wildfires on their own do the work of fuel treatments?

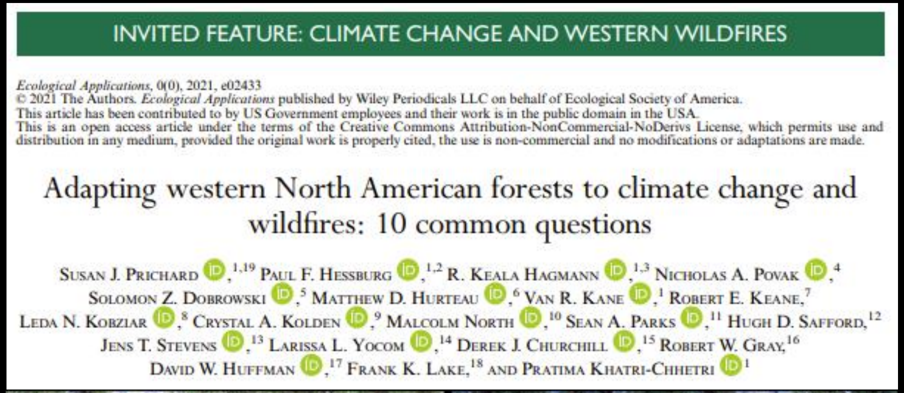
6) Is the primary objective of fuel reduction treatments to assist in future firefighting response and containment?

7) Do fuel treatments work under extreme fire weather?

8) Is the scale of the problem too great? Can we ever catch up?

9) Will planting more trees mitigate climate change in western North American forests?

10) Is post-fire management needed or even ecologically justified?



INVITED FEATURE: CLIMATE CHANGE AND WESTERN WILDFIRES

Ecological Applications, 0(0), 2021, e02433

Adapting western North American forests to climate change and wildfires: 10 common questions

Susan J. Prichard[1,19] Paul F. Hessburg[1,2] R. Keala Hagmann[1,3] Nicholas A. Povak[4] Solomon Z. Dobrowski[5] Matthew D. Hurteau[6] Van R. Kane[1] Robert E. Keane,[7] Leda N. Kobziar[8] Crystal A. Kolden[9] Malcolm North[10] Sean A. Parks[11] Hugh D. Safford,[12] Jens T. Stevens[13] Larissa L. Yocom[14] Derek J. Churchill[15] Robert W. Gray,[16] David W. Huffman[17] Frank K. Lake,[18] and Pratima Khatri-Chhetri[1]

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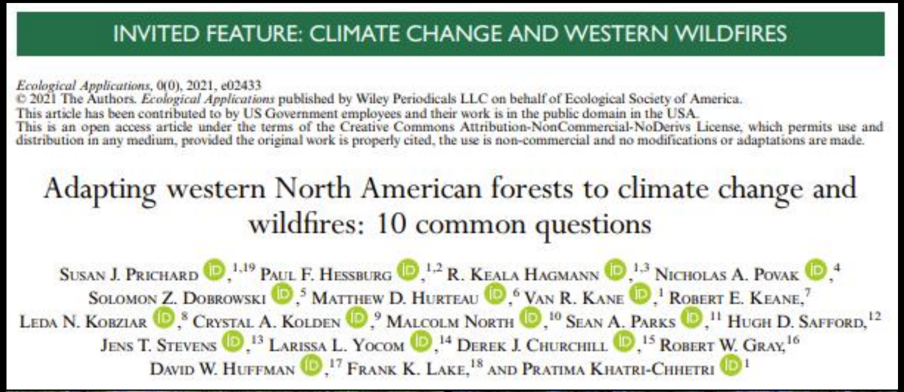
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Question 1:

Are the effects of fire exclusion overstated?

If so, are treatments unwarranted and even counterproductive?

Ecological Applications, 0(0), 2021, e02431

Evidence for widespread changes in the structure, composition, and fire regimes of western North American forests

R. K. Hagmann,[1,2,27] P. F. Hessburg,[1,3] S. J. Prichard,[1] N. A. Povak,[3,4] P. M. Brown,[5] P. Z. Fulé,[6] R. E. Keane,[7] E. E. Knapp,[8] J. M. Lydersen,[9] K. L. Metlen,[10] M. J. Reilly,[11] A. J. Sánchez Meador,[12] S. L. Stephens,[13] J. T. Stevens,[14] A. H. Taylor,[15] L. L. Yocom,[16] M. A. Battaglia,[17] D. J. Churchill,[18] L. D. Daniels,[19] D. A. Falk,[20,26] P. Henson,[21] J. D. Johnston,[22] M. A. Krawchuk,[22] C. R. Levine,[23] G. W. Meigs,[18] A. G. Merschel,[22] M. P. North,[24] H. D. Safford,[25] T. W. Swetnam,[26] and A. E. M. Waltz[12]

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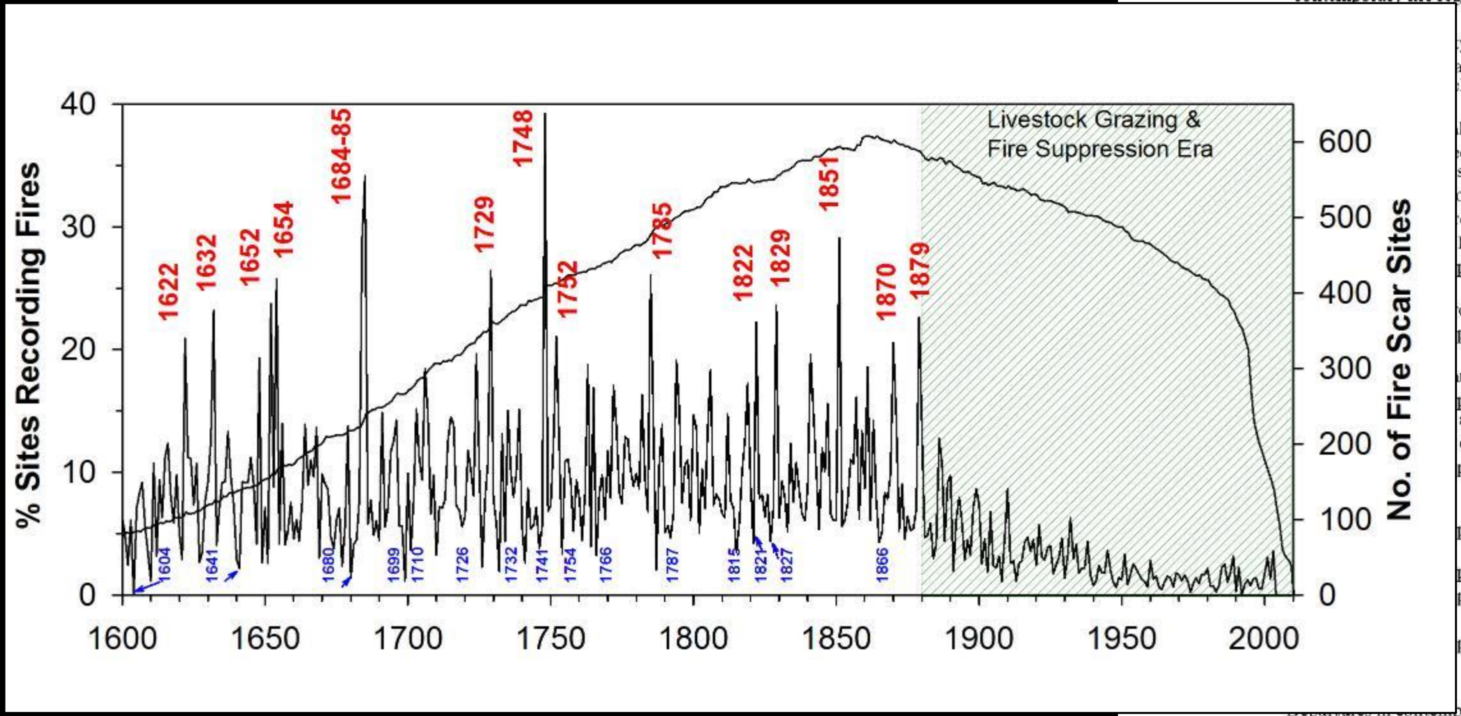
Citation: Hagmann, R. K., P. F. Hessburg, S. J. Prichard, N. A. Povak, P. M. Brown, P. Z. Fulé, R. E. Keane, E. E. Knapp, J. M. Lydersen, K. L. Metlen, M. J. Reilly, A. J. Sánchez Meador, S. L. Stephens, J. T. Stevens, A. H. Taylor, L. L. Yocom, M. A. Battaglia, D. J. Churchill, L. D. Daniels, D. A. Falk, P. Henson, J. D. Johnston, M. A. Krawchuk, C. R. Levine, G. W. Meigs, A. G. Merschel, M. P. North, H. D. Safford, T. W. Swetnam, and A. E. M. Waltz. 2021. Evidence for widespread changes in the structure, composition, and fire regimes of western North American forests. Ecological Applications 00(00):e02431. 10.1002/eap.2431

Abstract. Implementation of wildfire- and climate-adaptation strategies in seasonally dry forests of western North America is impeded by numerous constraints and uncertainties. After more than a century of resource and land use change, some question the need for proactive management, particularly given novel social, ecological, and climatic conditions. To address this question, we first provide a framework for assessing changes in landscape conditions and fire regimes. Using this framework, we then evaluate evidence of change in contemporary conditions relative to those maintained by active fire regimes, i.e., those uninterrupted by a century or more of human-induced fire exclusion. The cumulative results of more than a century of

100+ years of documenting change



Swetnam et al. 2016

TABLE 1. A sample of the regional syntheses and meta-analyses providing multi-proxy, multi-scale assessments of historical and contemporary forest and fire ecology.

Region and description	Citations
Western North America	
More than 800 fire-scar studies documented abrupt decline in fire frequency in the late 19th century and provide ecological insights into variation in top-down and bottom-up drivers of historical fire regimes.	Falk et al. (2011), Swetnam et al. (2016), Daniels et al. (2017)
Substantial departures in contemporary fire regimes and live and dead vegetation patterns across dry, moist, and cold forested landscapes increase vulnerability of forest ecosystems to drought and fire.	Hessburg et al. (2019)
Canada	
Development and paradigm shift in wildland fire research over past 50 yr.	Coogan et al. (2020)
Climate change impacts on fire regimes and impacts of contemporary fire regimes on social and ecological systems.	Coogan et al. (2019)
…y over the past 3,000 yr.	Marlon et al. (2012)
…area expected to burn without fire suppression …climate 1984–2012; area burned and fire severity	Parks et al. (2015), Parks and Abatzoglou (2020)
…l tribal perspectives on ecosystem restoration.	Long et al. (2020), Roos et al. (2021)
…en conifer species traits conferring fire resistance …ssments of historical fire regimes.	Stevens et al. (2020)
…ontemporary fire regimes.	Balch et al. (2017)
…regeneration up to 69 yr post fire.	Stevens-Rumann and Morgan (2019)
…Front Ranges	
…porary ecology of ponderosa pine and dry	Addington et al. (2018)
…osa pine forests.	McKinney (2019)
…porary ecology of selected national forests.	Dillon et al. (2005), Meyer et al. (2005*a*, *b*), Veblen and Donnegan (2005)
…tes	
…porary ecology of ponderosa pine and dry …and forest–grassland landscape complexes.	Reynolds et al. (2013), Dewar et al. (2021)
…of California	
…porary ecology of ponderosa and Jeffrey pine and	SNEP (1996), North et al. (2009, 2016), Safford and Stevens (2017), van Wagtendonk et al. (2018*a*)
…porary ecology of red fir and subalpine forest	Meyer and North (2019), Coppoletta et al. (2021)
…plateaus	
…porary ecology of dry conifer forests.	Riegel et al. (2018), Dumroese and Moser (2020)
…porary ecology of forested landscapes.	Skinner et al. (2018), Stephens et al. (2018*b*, 2019), Bohlman et al. (2021)
…porary fire regimes.	Reilly et al. (2017), Metlen et al. (2018), Haugo et al. (2019)
Historical and contemporary ecology of ponderosa pine forests in Oregon and Washington; vulnerability of contemporary forests and expanding wildland urban interface to increasing drought and fire severity.	Merschel et al. (2021)
Historical and contemporary ecology of moist mixed conifer forests in seasonally dry landscapes in Oregon, Washington, and Northern California.	Perry et al. (2011), Spies et al. (2018*b*, 2019), Stine et al. (2014), Hessburg et al. (2016)
Columbia River Basin in northwestern United States	
The Interior Columbia Basin Ecosystem Management Project	Lehmkuhl et al. (1994), Huff et al. (1995),

Decades of challenges

- Abundant time and resources invested to evaluate objections
  - Historical fire frequency and severity
  - Historical forest density
  - Contemporary fire severity
- Track record, moving target, critical errors
  - Our conclusion: "… these counter-evidence publications are weakened by multiple methodological errors and warrant critical reevaluation … [they] do not meet minimum standards for 'best available science'…"

Evaluation of Counter evidence

- Even stronger evidence of departures associated with more than a century of fire exclusion
  - Increased abundance and connectivity of fuels
  - Altered fire regimes

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TABLE 6. Publications presenting (1) counter-evidence asserting that modern wildfires are compa severity of modern fires is overestimated and (2) evaluations of methods and inferences in counter-

Counter-evidence		Evaluation of counte	
Citations	Counter-premise	Citations	Imp
Odion and Hanson (2006)	High-severity fire was rare in recent fires in the Sierra Nevada based on analysis of Burned Area Emergency Response (BAER) soil burn severity maps	Safford et al. (2008)	BAER maps replacing f burn severi are soil bur burn-severi

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TABLE 5. Continued

Counter-evidence		Evaluation of counter-evidence	
Citations	Counter-premise	Citations	Implications of evaluation
Baker and Hanson (2017)	Stephens et al. (2015) underrepresented the	Hagmann et al. (2018)	Substantial errors of method and interpretation invalidate inferences about the historical extent of high-severity fire

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TABLE 5. Publications presenting (1) counter-evidence asserting that modern wildfires are not unlike historical fires because severity of historical fires is underestimated and (2) evaluations of methods and inferences in counter-evidence publications.

Counter-evidence		Evaluation of counter-evidence	
Citations	Counter-premise	Citations	Implications of evaluation
Shinneman and Baker (1997)	Based on early forest inventory age data sets, "nonequilibrium" areas of extensive, high-severity fires in the Black Hills led to landscapes dominated by dense, closed-canopy forests.	Brown (2006)	Tree-ring reconstructions of ponderosa pine forest age structures and fire regimes across the Black Hills found synchronous regional tree recruitment largely in response to pluvials and longer intervals between surface fires, especially during the late 1700s/early 1800s, which is when early inventory data report similar patterns of recruitment. No evidence of crown fires was found in relation to past fire dates.
	Most ponderosa pine forests in the Rocky Mountains were capable of supporting high-severity crown fires as well as low-severity surface fires.	Brown et al. (2008)	Tree-ring reconstruction of ponderosa pine forests in the Black Hills of South Dakota (included in Baker et al. 2007) demonstrated that roughly 3.3% of the study area burned as crown fire between 1529 and 1893; however, tree density in most stands in 1870 could not have supported crown fire.
	Fire severity inferred from tree density by size class estimated from GLO bearing trees (Williams and Baker 2011) and surveyors' descriptions suggests low-severity fire dominated only a minority of ponderosa and mixed-conifer forests.	Levine et al. (2017, 2019)	Plotless density estimator used by Williams and Baker (2011) overestimated known tree densities due to a scaling factor that does not correct for the number of trees sampled and therefore systematically underestimates the area per tree relationship.
		Fulé et al. (2014), Merschel et al. (2014), O'Connor et al. (2017)	Substantial errors of method and interpretation invalidate inferences about historical fire severity. These include (1) tree size is an ambiguous indicator of tree age; (2) tree regeneration is an ambiguous indicator of disturbance severity, particularly in dry forests where climate conditions strongly influence regeneration; and (3) lack of direct documentary evidence (e.g., primary observation) of extensive crown fire in historical ponderosa pine forests has been widely noted for nearly 90 yr.
		Stephens et al. (2015), Huffman et al. (2015), Miller and Safford (2017), Hagmann et al. (2019)	Multi-proxy records documented substantially lower levels of high-severity fire in ponderosa and Jeffrey pine and mixed-conifer forests in overlapping study areas.
	Estimates of area burned at high severity in Hessburg et al. (2007) validate	Hagmann et al. (2018), Spies et al. (2018a)	Inappropriate comparisons are not validation. Baker (2012) limited assessment of high-severity fire to tree mortality in dry forests whereas Hessburg et al. (2007) estimated high-severity fire in the dominant cover type whether that be

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TABLE 4. Publications presenting (1) counter-evidence asserting that tree-ring reconstructions overestimate fire frequency and rotation and (2) evaluations of methods and inferences in counter-evidence publications.

Counter-evidence		Evaluation of counter-evidence	
Citations	Counter-premise	Citations	Implications of evaluation
Baker and Ehle (2001, 2003) Ehle and Baker	Tree-ring reconstructions misrepresent historical	Collins and Stephens (2007)	Unrecorded fires (fire did not scar the tree) may contribute to underestimation, not overestimation, of fire frequency and extent in frequent fire systems. ...decreased when intervals were short in areas burned by ...tury fires. Absence of scar ...e of fire. ...scar interval erroneously ...es that survive fire are ...us indicator of fire-free ...e included in calculations of ...establishment may not ...g disturbance in dry forests ...rongly associated with climate. ...dded), and random sampling ...l mountain range scales have ...l fire frequencies similar to ...eted sampling within forest ...t comparison studies, no ...targeted sampling of fire- ...l estimates. Targeted ...fire parameters comparable ...stematic sampling of both a ...ll trees in a study area and

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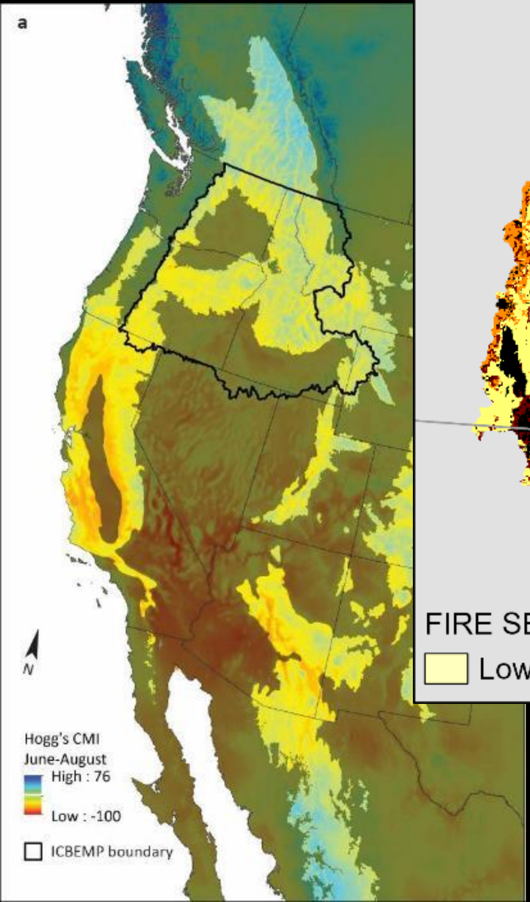
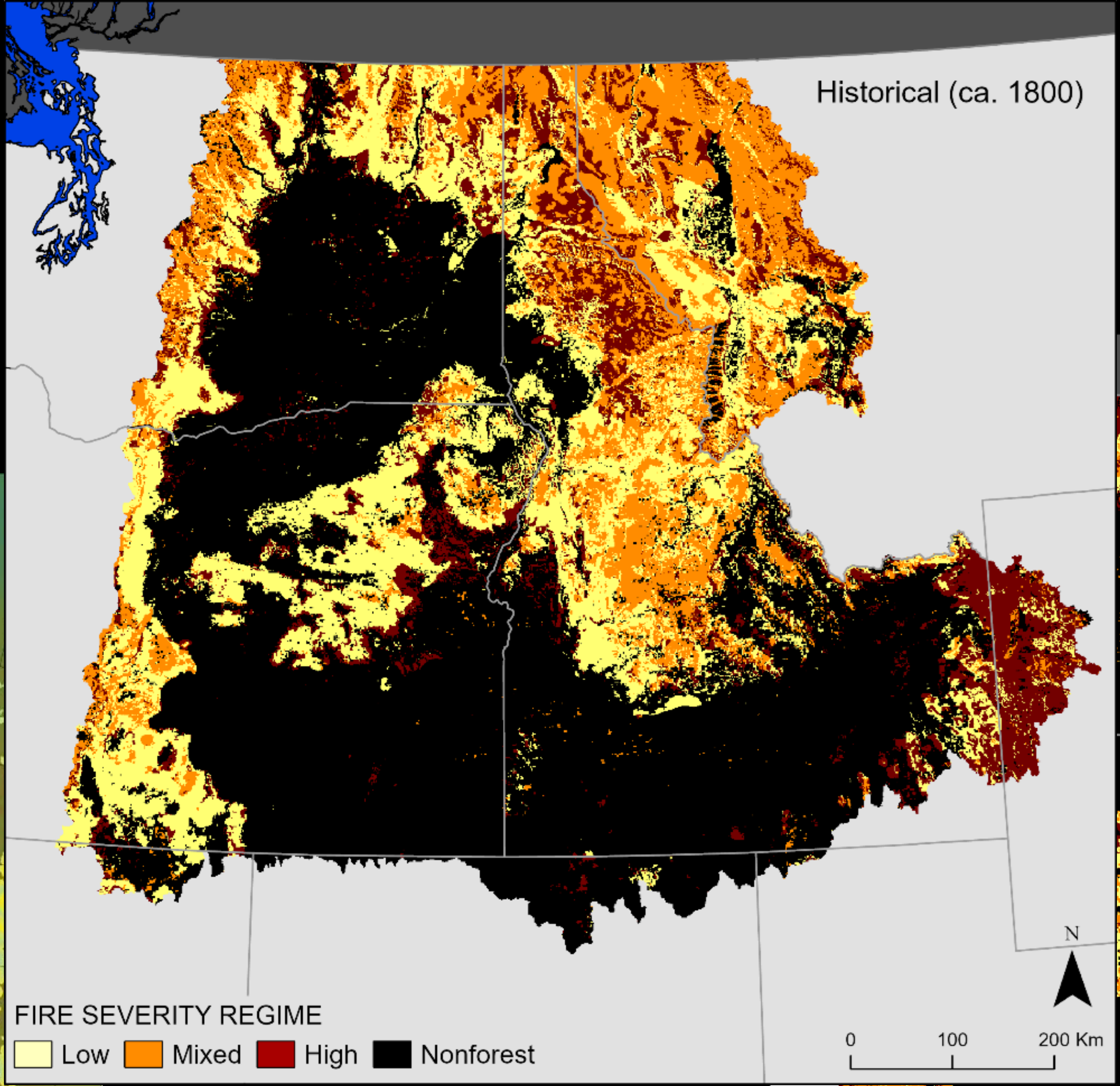
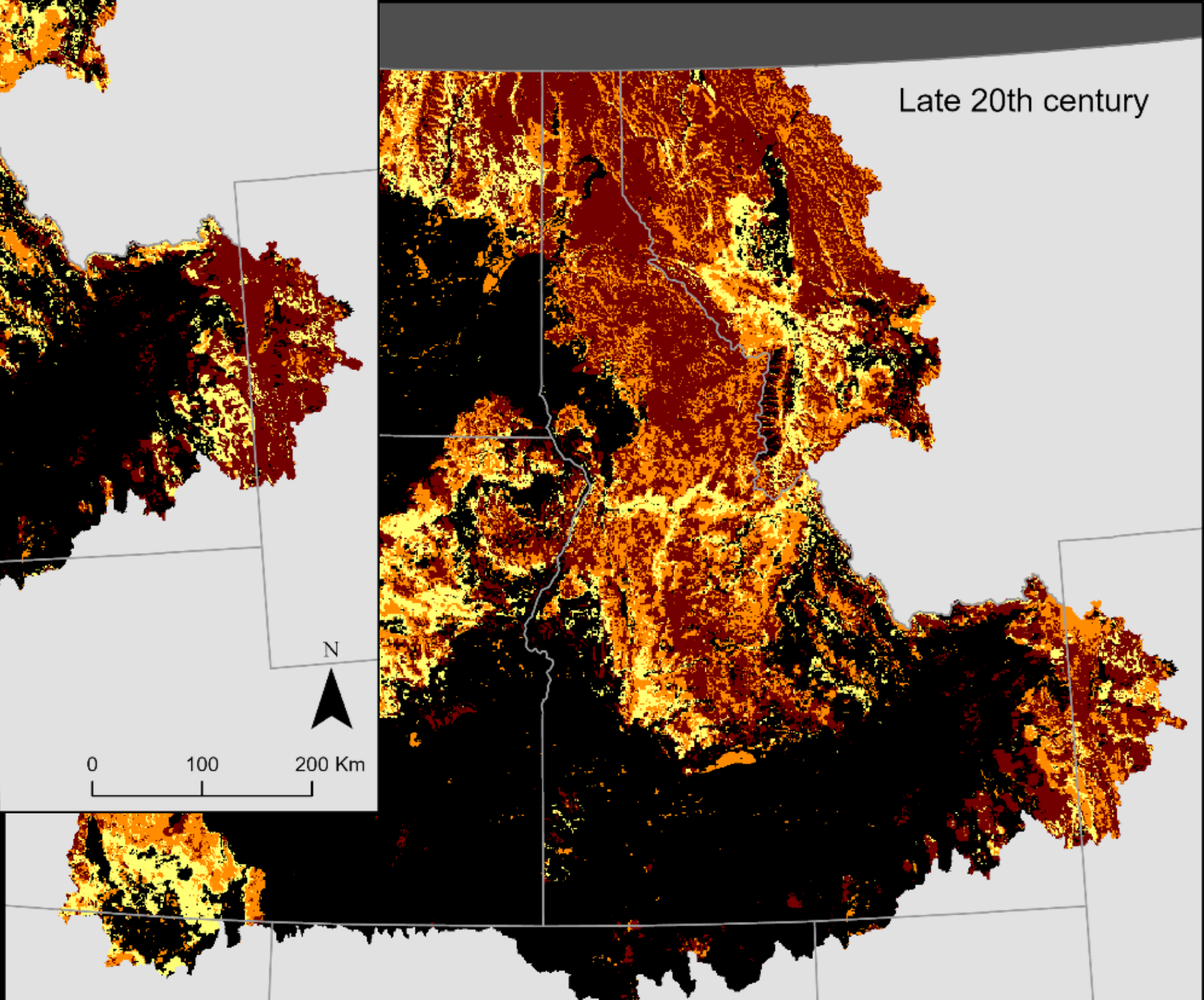
TABLE 3. Publications presenting (1) counter-evidence asserting that forests were denser than previously thought and (2) evaluations of methods and inferences in counter-evidence publications.

Counter-evidence		Evaluation of counter-evidence	
Citations	Counter-premise	Citations	Implications of evaluation
Williams and Baker (2011) Baker and Williams (2018)	Novel methods provide estimates of tree density from point data, *i.e.*, General Land Office (GLO) records of bearing trees.	Levine et al. (2017, 2019)	Multiple existing plotless density estimators (PDE) provided less biased estimates than the PDE developed by Williams and Baker (2011), which overestimated known tree densities by 24–667% in contemporary stands.
		Knight et al. (2020)	Methods supported by PDE sampling theory and multiple accuracy assessments further demonstrate the potential for misrepresentation of historical tree density by biased estimators used at resolutions substantially





Adapted from Hessburg et al. 2005



Recent fires too much high severity

- Extensive high-severity fire effects now overly abundant in historically maintained by abundant low- to moderate-severity fire
- Larger and more abundant patches of nonforest in fire-excluded landscapes

TABLE 2. Continued

Citation	Key findings	Forest type	Methods	Study area
Safford and Stevens (2017) (Fig. 6 adapted	Area burned at high severity in modern fires exceeded estimates of area burned prior	Ponderosa and Jeffrey pine and mixed conifer	Compared modern fires (1984–2004, RdNBR) with Landfire BPS model	Sierra Nevada, California

TABLE 2. High-severity fire effects in recent fires exceed the pre-fire exclusion range of variation in landscapes historically dominated by frequent low- and moderate-severity fires.

Citation	Key findings	Forest type	Methods	Study area
Mallek et al. (2013)	In lower and middle elevation forests, area burned at low- to moderate-severity fire is substantially lower than expected while severity in recent fires is much higher than estimated for conditions prior to fire exclusion. Fires of all severities are at a deficit in upper elevation forests.	Lower (oak woodlands to ponderosa and Jeffrey pine), middle (mixed conifer), and upper (red fir and subalpine forest) elevation forests.	Compared fire severity distributions in modern (1984–2009) fires based on relative delta normalized burn ratio (RdNBR) with pre-fire exclusion fires based on average of LANDFIRE Biophysical Settings (BPS) and Stephens et al. (2007).	Sierra Nevada and southern Cascade Ranges, California
O'Connor et al. (2014)	Conversion of more than 80% of landscape from frequent low- to mixed-severity fire regime to one of infrequent moderate- to high-severity fire. Current high fuel loads shift climate drivers of fire behavior: (1) extreme drought no longer necessary for fire spread to mesic forest types and (2) antecedent moist conditions no longer necessary for spreading fires.	Pine and dry mixed conifer	Compared fire size and severity distributions in modern (1996 and 2004, RdNBR) fires with size and severity of fires prior to 1880 reconstructed from a gridded tree-ring sampling network.	Pinaleño Mountains, southeastern Arizona
Harris and Taylor (2015)	Increases in tree density, basal area, and fuels due to fire exclusion since 1899 shifted fire regime from frequent low severity to mixed severity.	Mixed conifer	Compared fire severity in 2013 (RdNBR) with fire severity prior to 1899 reconstructed from documentary records, radial growth of tree rings, fire-scars, and tree-age structure.	2013 Rim Fire, Yosemite National Park, California
Yocom-Kent et al. (2015)	Largest (>1,000 ha) high-severity patches in modern (2000–2012) fires exceeded those reconstructed for 1,400 ha study area; however, cannot rule out stand-replacing fire prior to mid-1700s	Mixed conifer and aspen	Compared high-severity fire patch size in modern (2000–2012) fires reconstructed from ground-truthing of satellite imagery with historical fires reconstructed from fire-scar and tree-age data.	North Rim, Grand Canyon National Park, Arizona
Fornwalt et al. (2016)	Tree(s) >200 yr old present in 4% area after fire compared to 70% before fire.	Unlogged ponderosa and ponderosa–Douglas-fir	Compared 2013 aerial imagery to pre-fire age structure in randomly selected polygons.	2002 Hayman fire, Colorado
Rivera-Huerta et al. (2016)	Following 30 yr of fire suppression, increasing high-severity patch size; fires remain easy to suppress and	Jeffrey pine and mixed conifer	Quantified area burned at high-severity in fires from the onset of fire suppression (roughly 1984)	Baja California, Mexico

Question 2:
Can thinning alone mitigate wildfire severity?

INDEPENDENT

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Trump issues executive order to increase logging and deforestation in bid to tackle wildfires

US president launched order that expands logging on grounds it will curb wildfires

Darryl Fears, Juliet Eilperin | Tuesday 15 January 2019 10:03

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Logging and Thinning Helps Reduce Wildfire Risks

healthyforests July 21, 2021 News

Active forest management, including thinning fire-prone forests, is a good way to reduce the risk of forest fires.

Decades of lack of management have left federal forests overstocked with disease and insect ridden trees and standing dead timber that fuel catastrophic wildfires.

Over 80 million acres of national forests are at risk of severe wildfire and need active forest management. Proven, science-based forest management tools like logging, thinning, and controlled burns reduce excessive vegetation that fuel catastrophic wildfires. Active management protects the environment by helping forests adapt to changing conditions, reducing massive carbon emissions from wildfire, and creating renewable building materials that store carbon.

Review articles

Scientific consensus:

Thinning alone can sometimes be effective, but prescribed burning is generally necessary to reduce surface fuels and mitigate future fire behavior and effects.

Forest Ecology and Management 269 (2012) 68–81

Contents lists available at SciVerse ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

ELSEVIER

Review

Do thinning and/or burning treatments in western USA ponderosa or Jeffrey pine-dominated forests help restore natural fire behavior?

Peter Z. Fulé [a,*], Joseph E. Crouse [b], John Paul Roccaforte [b], Elizabeth L. Kalies [b]

[a] School of Forestry, Northern Arizona University, 200 East Pine Knoll Drive, Room 116, Flagstaff, AZ 86011-5018, USA
[b] Ecological Restoration Institute, Northern Arizona University, 200 East Pine Knoll Drive, Room 116, Flagstaff, AZ 86011-5018, USA

United States Department of Agriculture
Forest Service
Rocky Mountain Research Station
Research Paper RMRS-RP-103WWW
June 2013

Fuel Treatments and Fire Severity: A Meta-Analysis

Erik J. Martinson and Philip N. Omi

Forest Ecology and Management 375 (2016) 84–95

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

Tamm Review: Are fuel treatments effective at achieving ecological and social objectives? A systematic review

Elizabeth L. Kalies [a,*], Larissa L. Yocom Kent [b]

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[b] School of Forestry, Northern Arizona University, PO Box 15017, Flagstaff, AZ 86011-5017, United States

The Effects of Forest Fuel-Reduction Treatments in the United States

June 2012 / Vol. 62 No. 6 • BioScience 549

SCOTT L. STEPHENS, JAMES D. McIVER, RALPH E. J. BOERNER, CHRISTOPHER J. FETTIG, JOSEPH B. FONTAINE, BRUCE R. HARTSOUGH, PATRICIA L. KENNEDY, AND DYLAN W. SCHWILK

Virginia Ridge Timber Sale

Question 3:
Can thinning and prescribed burning solve the problem?

Indigenous Fire Stewardship, Fig. 3 Fire Keeper Pierre Krueger, Penticton Indian Band, conducting a cultural burn in the Nicola Valley, British Columbia." (Photo credit: A.C. Christianson, CFS)

CULTURAL BURNING

"Fire itself is sacred. It renews life. It shades rivers and cools the water's temperature. It clears brush and makes for sufficient food for large animals. ,,. Fire does so much more than western science currently understands."

Bill Tripp, Our land was taken. But we still hold the knowledge of how to stop mega-fires

https://www.fs.fed.us/psw/publications/lake/psw_2019_lake001.pdf

https://eos.org/features/fire-as-medicine-learning-from-native-american-fire-stewardship

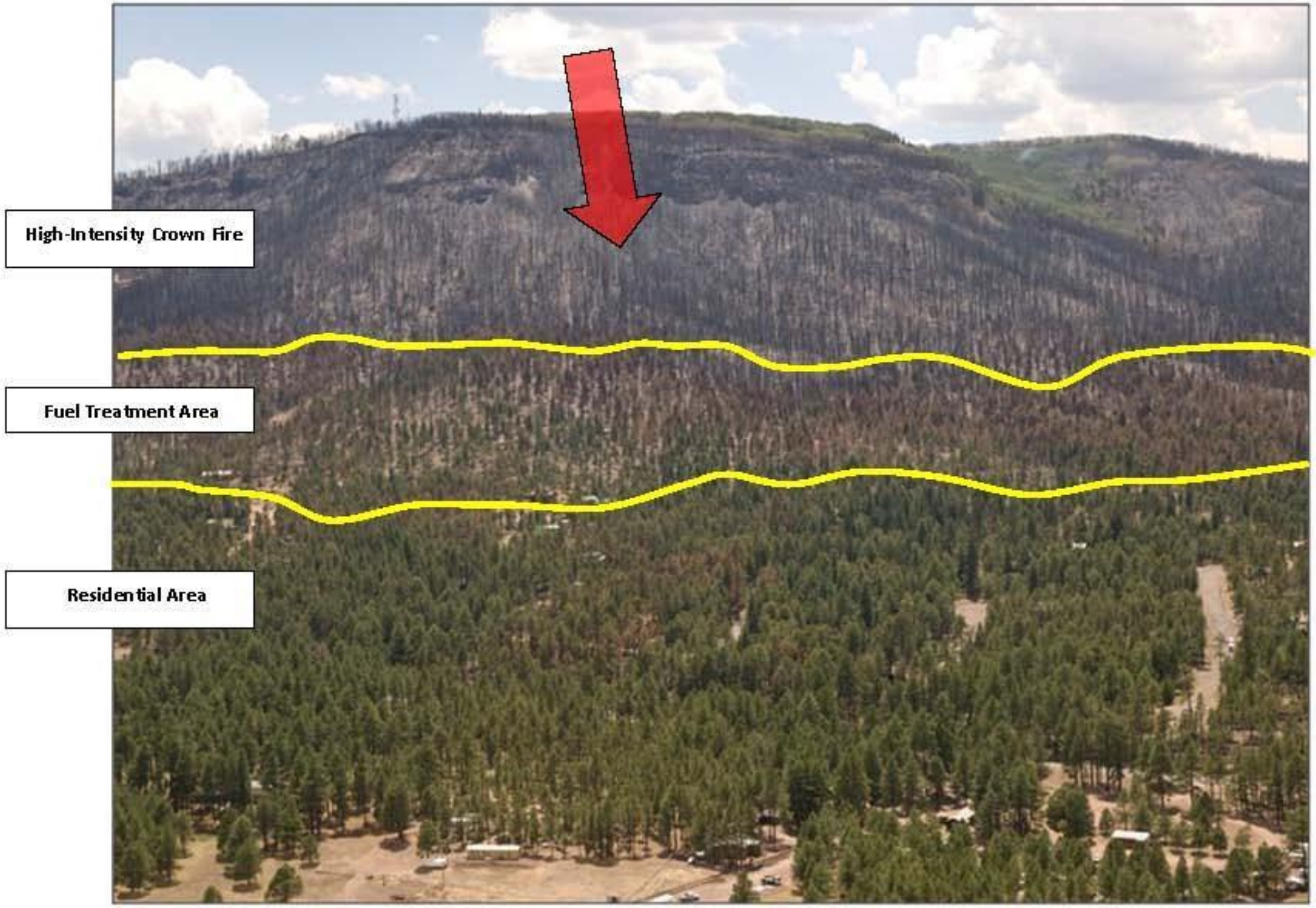
Cold Forests

Question 4:

Should active forest management, including forest thinning, be concentrated in the wildland urban interface (WUI)?

"Overall, a shift in resources from the defense of the WUI from wildfire to the mitigation of wildfire hazards and risks in advance of events will build a safe operating space for fire-prone communities that increases adaptive resilience to wildfire."
Schoennagel et al. 2017 - Adapt to more wildfire in western North American forests as climate changes

How Fuel Treatments Saved Homes from the Wallow Fire



Homes Saved

Red arrow indicates the direction of the crown fire's spread toward the Alpine community's homes. Yellow lines delineate the approximate location of the Alpine Wildland-Urban Interface Unit 2 Fuel Treatment Area. As the fire raced downslope, numerous Alpine houses were at risk from the crown fire. (While only a few of the house roofs can be seen in this photo, approximately 40 homes are located in this area—and a total of 100 homes were threatened in south Alpine.) Just as was illustrated in the photo on the previous page, this photo also shows how the fuel treatment area slowed and diminished the Wallow Fire's intensity, helping to save these homes.

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5358240.pdf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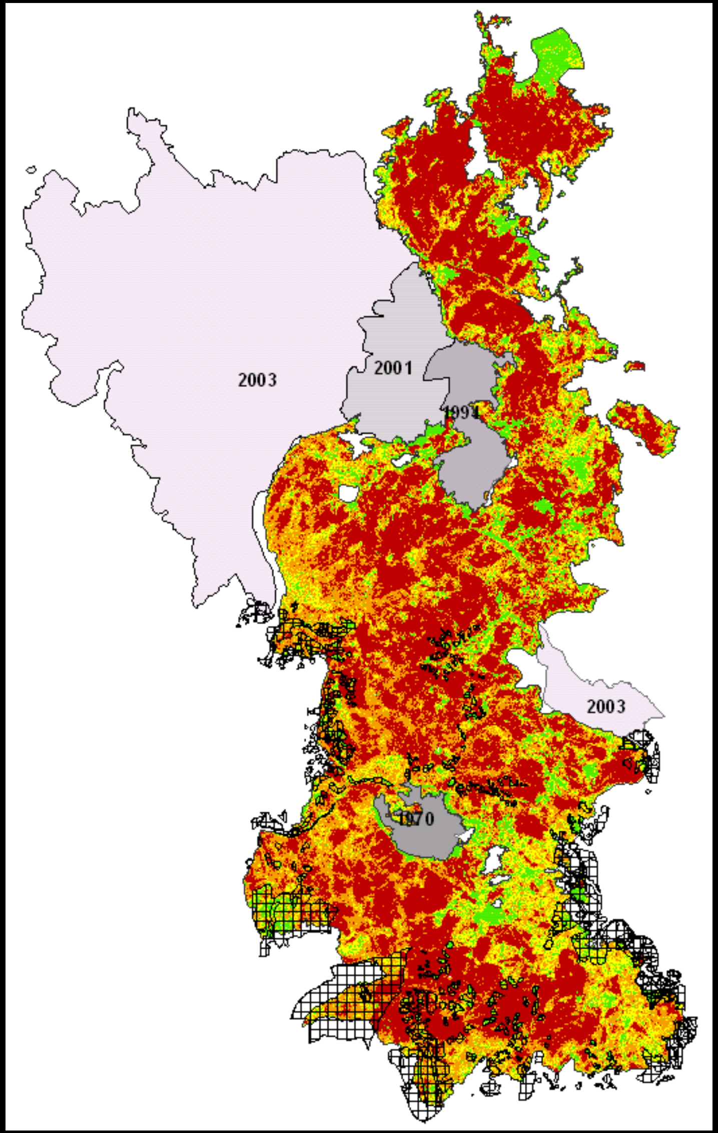
2006 Tripod Complex



Severity Class
High
Moderate
Low
Unburned

Question 5:
Can wildfires can do the work of fuel treatments?

“Fire alone can restore its past influence as a patchwise and stand-thinning disturbance agent as well as a facilitator of species diversity and fire-adapted conifers in these forests.”

Odion and Hanson 2006

Recent fires too much high severity

- Extensive high-severity fire effects now overly abundant in historically maintained by abundant low- to moderate-severity fire
- Larger and more abundant patches of nonforest in fire-excluded landscapes

TABLE 2. Continued

Citation	Key findings	Forest type	Methods	Study area
Safford and Stevens (2017) (Fig. 6 adapted	Area burned at high severity in modern fires exceeded estimates of area burned prior	Ponderosa and Jeffrey pine and mixed conifer	Compared modern fires (1984–2004, RdNBR) with Landfire BPS model	Sierra Nevada, California

TABLE 2. High-severity fire effects in recent fires exceed the pre-fire exclusion range of variation in landscapes historically dominated by frequent low- and moderate-severity fires.

Citation	Key findings	Forest type	Methods	Study area
Mallek et al. (2013)	In lower and middle elevation forests, area burned at low- to moderate-severity fire is substantially lower than expected while severity in recent fires is much higher than estimated for conditions prior to fire exclusion. Fires of all severities are at a deficit in upper elevation forests.	Lower (oak woodlands to ponderosa and Jeffrey pine), middle (mixed conifer), and upper (red fir and subalpine forest) elevation forests.	Compared fire severity distributions in modern (1984–2009) fires based on relative delta normalized burn ratio (RdNBR) with pre-fire exclusion fires based on average of LANDFIRE Biophysical Settings (BPS) and Stephens et al. (2007).	Sierra Nevada and southern Cascade Ranges, California
O'Connor et al. (2014)	Conversion of more than 80% of landscape from frequent low- to mixed-severity fire regime to one of infrequent moderate- to high-severity fire. Current high fuel loads shift climate drivers of fire behavior: (1) extreme drought no longer necessary for fire spread to mesic forest types and (2) antecedent moist conditions no longer necessary for spreading fires.	Pine and dry mixed conifer	Compared fire size and severity distributions in modern (1996 and 2004, RdNBR) fires with size and severity of fires prior to 1880 reconstructed from a gridded tree-ring sampling network.	Pinaleño Mountains, southeastern Arizona
Harris and Taylor (2015)	Increases in tree density, basal area, and fuels due to fire exclusion since 1899 shifted fire regime from frequent low severity to mixed severity.	Mixed conifer	Compared fire severity in 2013 (RdNBR) with fire severity prior to 1899 reconstructed from documentary records, radial growth of tree rings, fire-scars, and tree-age structure.	2013 Rim Fire, Yosemite National Park, California
Yocom-Kent et al. (2015)	Largest (>1,000 ha) high-severity patches in modern (2000–2012) fires exceeded those reconstructed for 1,400 ha study area; however, cannot rule out stand-replacing fire prior to mid-1700s	Mixed conifer and aspen	Compared high-severity fire patch size in modern (2000–2012) fires reconstructed from ground-truthing of satellite imagery with historical fires reconstructed from fire-scar and tree-age data.	North Rim, Grand Canyon National Park, Arizona
Fornwalt et al. (2016)	Tree(s) >200 yr old present in 4% area after fire compared to 70% before fire.	Unlogged ponderosa and ponderosa–Douglas-fir	Compared 2013 aerial imagery to pre-fire age structure in randomly selected polygons.	2002 Hayman fire, Colorado
Rivera-Huerta et al. (2016)	Following 30 yr of fire suppression, increasing high-severity patch size; fires remain easy to suppress and	Jeffrey pine and mixed conifer	Quantified area burned at high-severity in fires from the onset of fire suppression (roughly 1984)	Baja California, Mexico

Geophysical Research Letters

Research Letter

Warmer and drier fire seasons contribute to increases in area burned at high severity in western US forests from 1985-2017

S. A. Parks, J. T. Abatzoglou

First published: 22 October 2020 | https://doi.org/10.1029/2020GL089858

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ELSEVIER

Increasing trends in high-severity fire in the southwestern USA from 1984 to 2015

Megan P. Singleton[a,*], Andrea E. Thode[a], Andrew J. Sánchez Meador[a], Jose M. Iniguez[b]

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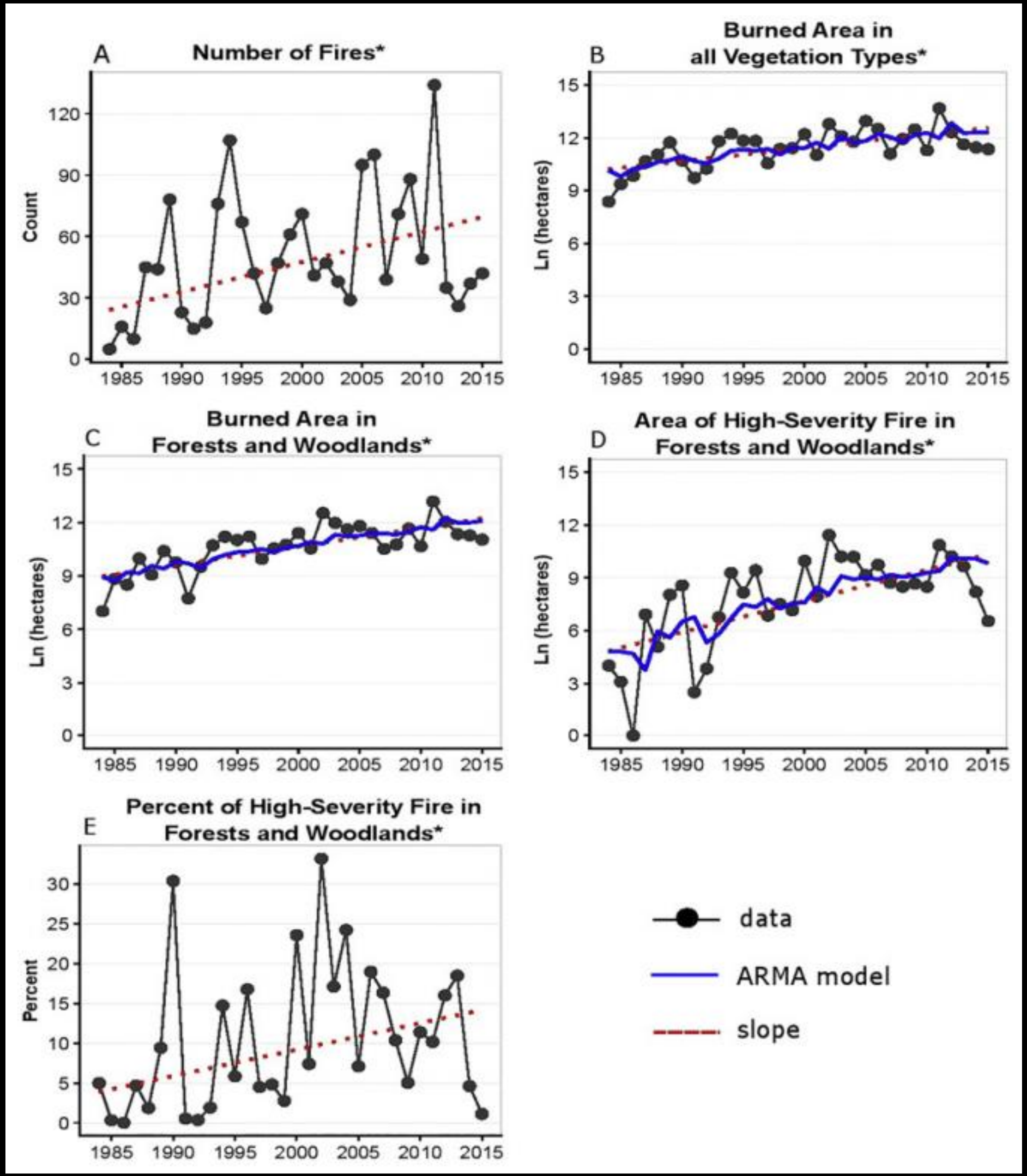


Question 6:

Is the primary objective of fuel treatments to contain wildfires?

"It is becoming more and more commonly accepted that reducing fuels does not consistently prevent large forest fires, and seldom significantly reduces the outcome of these large fires."

BARK vs US Forest Service
(9th District Court of Appeals ruling against a forest restoration project)

Recent media – Sacramento Bee

"This [set of fuel treatments] is not stopping fires, because they're mostly driven by weather and climate," [Chad] Hanson said. "You can't fight the wind with a chainsaw."

"The goal of these treatments is not to stop wildfires in their tracks. It's to change the behavior where we can," said Dan Porter, the California forest program director at The Nature Conservancy, which has worked with the Forest Service on thinning the projects in the Sierra.

Read more at: https://www.sacbee.com/news/california/fires/article254957722.html#storylink=cpy

Photo credit: Ryan Sabalow *RSABALOW@SACBEE.COM*

2015 North Star Fire

https://depts.washington.edu/nwfire/ncw/#t2a

Question 7:
Do fuel treatments work under extreme fire weather?

"Thinning is most often proposed to reduce fire risk and lower fire intensity… as the climate changes, most of our fires will occur during extreme fire-weather (high winds and temperatures, low humidity, low vegetation moisture). These fires, like the ones burning in the West this summer, will affect large landscapes, regardless of thinning, and, in some cases, burn hundreds or thousands of acres in just a few days."

Geos Institute Open Letter to Decision Makers Concerning Wildfires in the West

Examples where fuel treatments proved effective even during extreme fire weather:

2021 Bootleg Fire

- Thinning and burning units are some of the only green left in areas that burned when the fire was burning out of control.

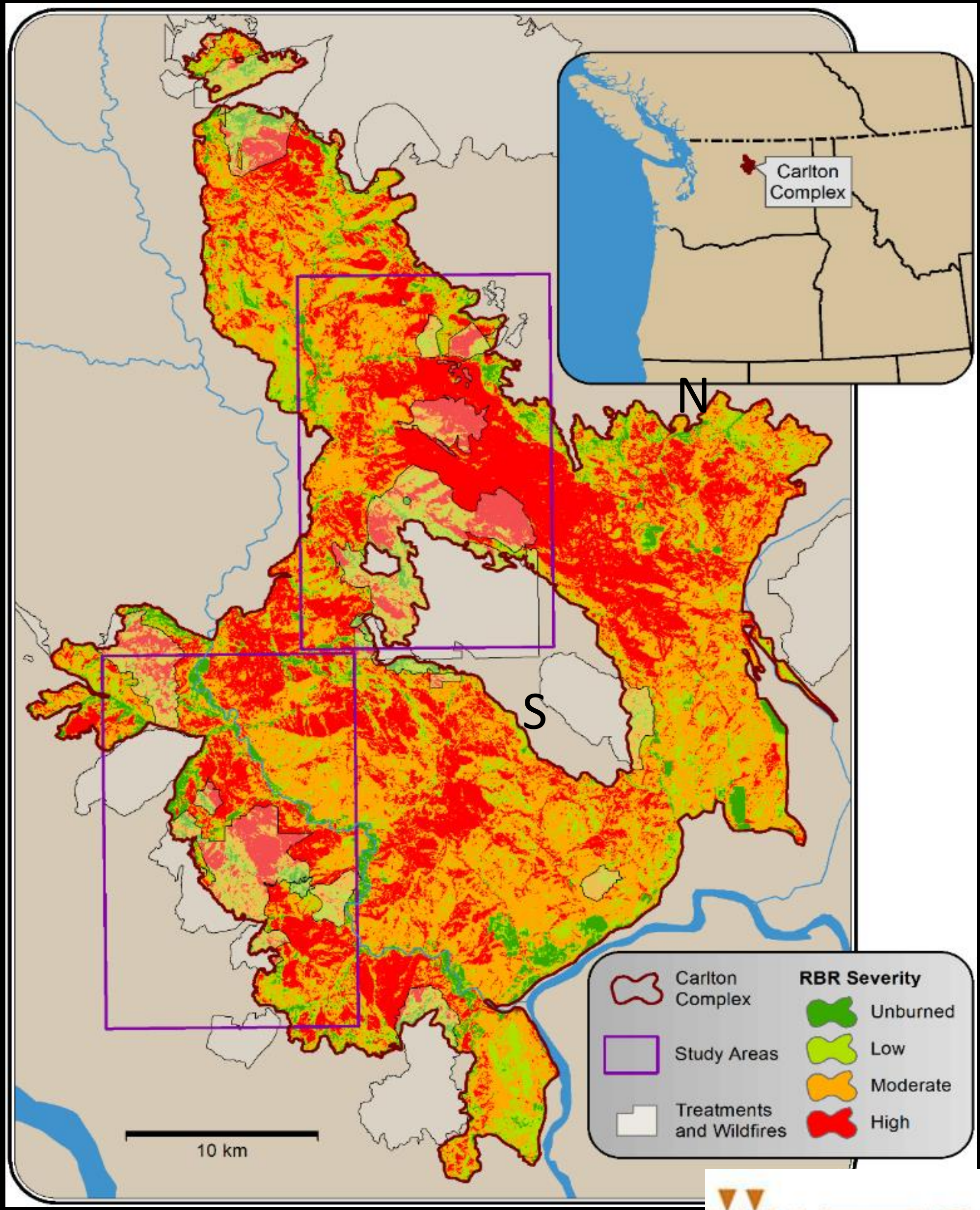
2013 Rim Fire

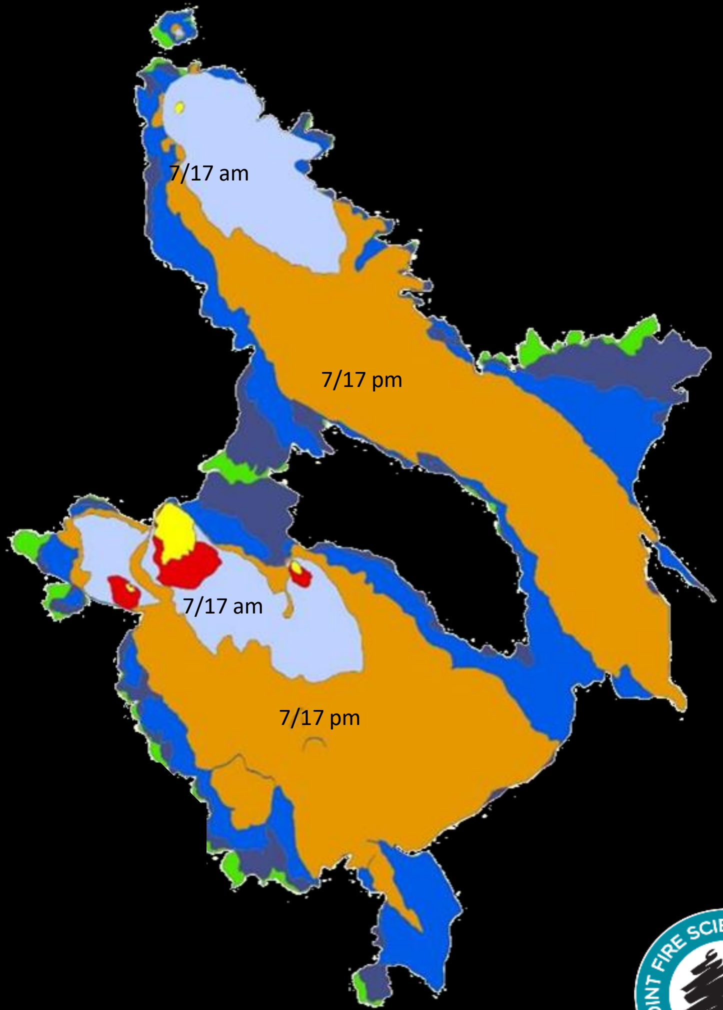
- Lydersen et al. 2017. Evidence of fuels management and fire weather influencing fire severity in an extreme fire event. Ecological Applications 27:2013–2030.
- Povak et al. 2020. Multi-scaled drivers of severity patterns vary across land ownerships for the 2013 Rim Fire, California. *Landscape Ecology*, *35*(2), 293-318.

2011 Los Conchas Fire

- Walker, R. B. et al. 2018. Fire regimes approaching historic norms reduce wildfire-facilitated conversion from forest to non-forest. Ecosphere 9:e02182.

2014 Carlton Complex





Western Wildland Environmental Threat Assessment Center

Ecological Applications, 0(0), 2020, e02104

Fuel treatment effectiveness in the context of landform, vegetation, and large, wind-driven wildfires

Susan J. Prichard [1,5] Nicholas A. Povak [2,3] Maureen C. Kennedy [4] and David W. Peterson [2]

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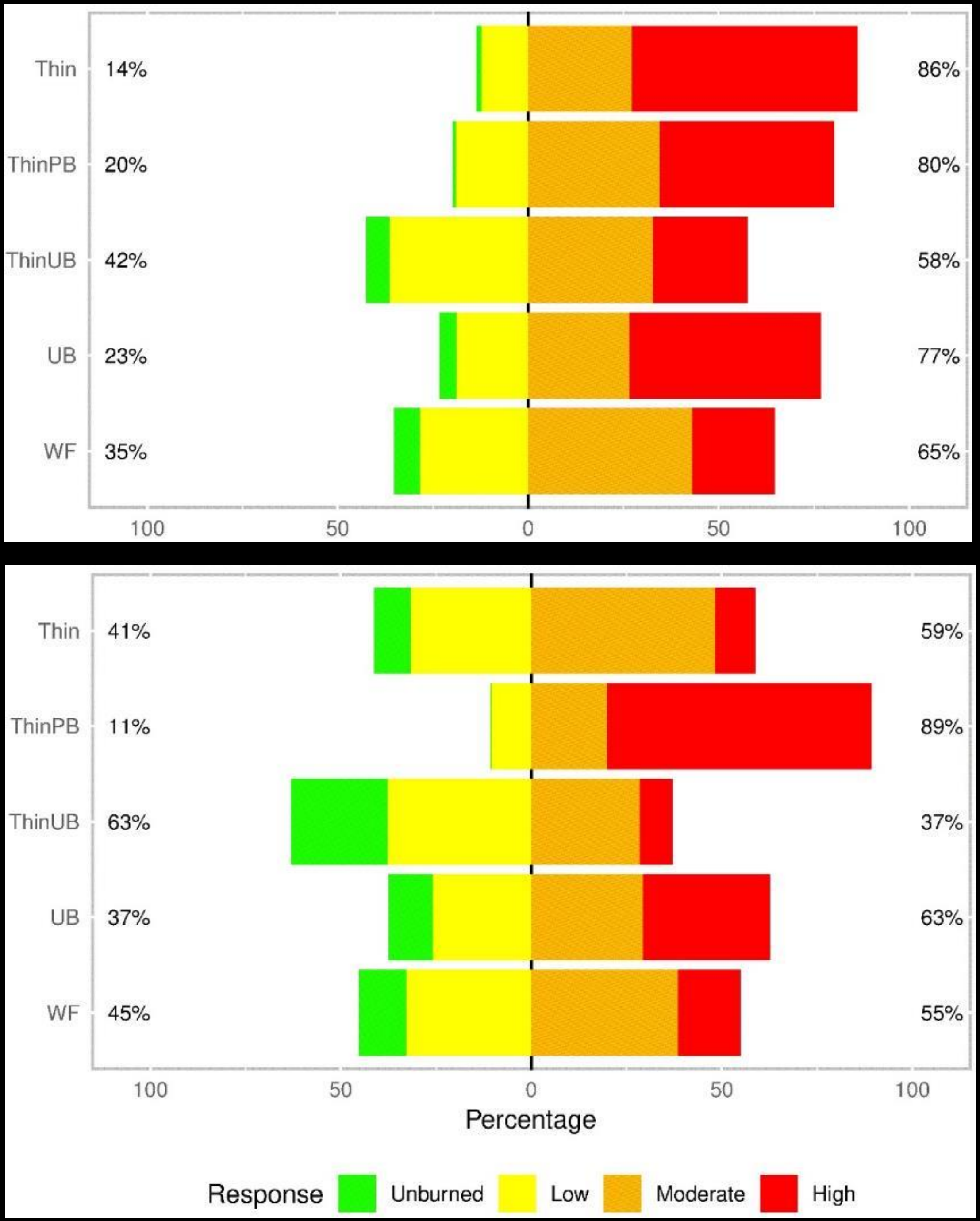
Citation: Prichard, Susan J., Nicholas A. Povak, >Maureen C. Kennedy, and David W. Peterson. 2020. Fuel treatment effectiveness in the context of landform, vegetation, and large, wind-driven wildfires. Ecological Applications 00(00):e02104. 10.1002/eap.2104

2014 Carlton Complex, Upper Finley Canyon

2014 Carlton Complex



Early Progressions (7/15 to 7/18)

Later Progressions (7/19 to 8/08)

Question 9:
Will planting more trees mitigate climate change in western North American forests?

Trees are the ultimate carbon sequestration device," … "Not only are we setting an ambitious goal of planting 1 trillion new trees by 2050, but we're also reinvesting resources into managing forests and using wood products. Since wood continues storing carbon long after the tree is cut down and turned into furniture or building materials, there is no limit to how much carbon we can sequester."

US Representative Bruce Westerman (AR)


Question 10:
Is post-fire management needed or even ecologically justified?

"There is an urgent need for initiatives that prevent high intensity fires in forests that are not adapted for them, and we'll need to get a whole lot better at post fire recovery…
Many in the environmental community instinctively approach recovery after disasters like this [the 2013 Rim Fire, CA] with a strategy of 'letting nature heal itself.' Unfortunately, that approach is likely to result in a forest dominated by shrubs for many decades."

Eric Holst, Environmental Defense Fund
https://www.edf.org/blog/2014/02/18/after-rim-fire-surprising-role-salvage-logging

Post-fire vegetation and fuel development influences fire severity patterns in reburns

September 2015 · Ecological Applications
DOI: 10.1890/15-0225.1

Michelle Coppoletta · Kyle Merriam · Brandon M. Collins

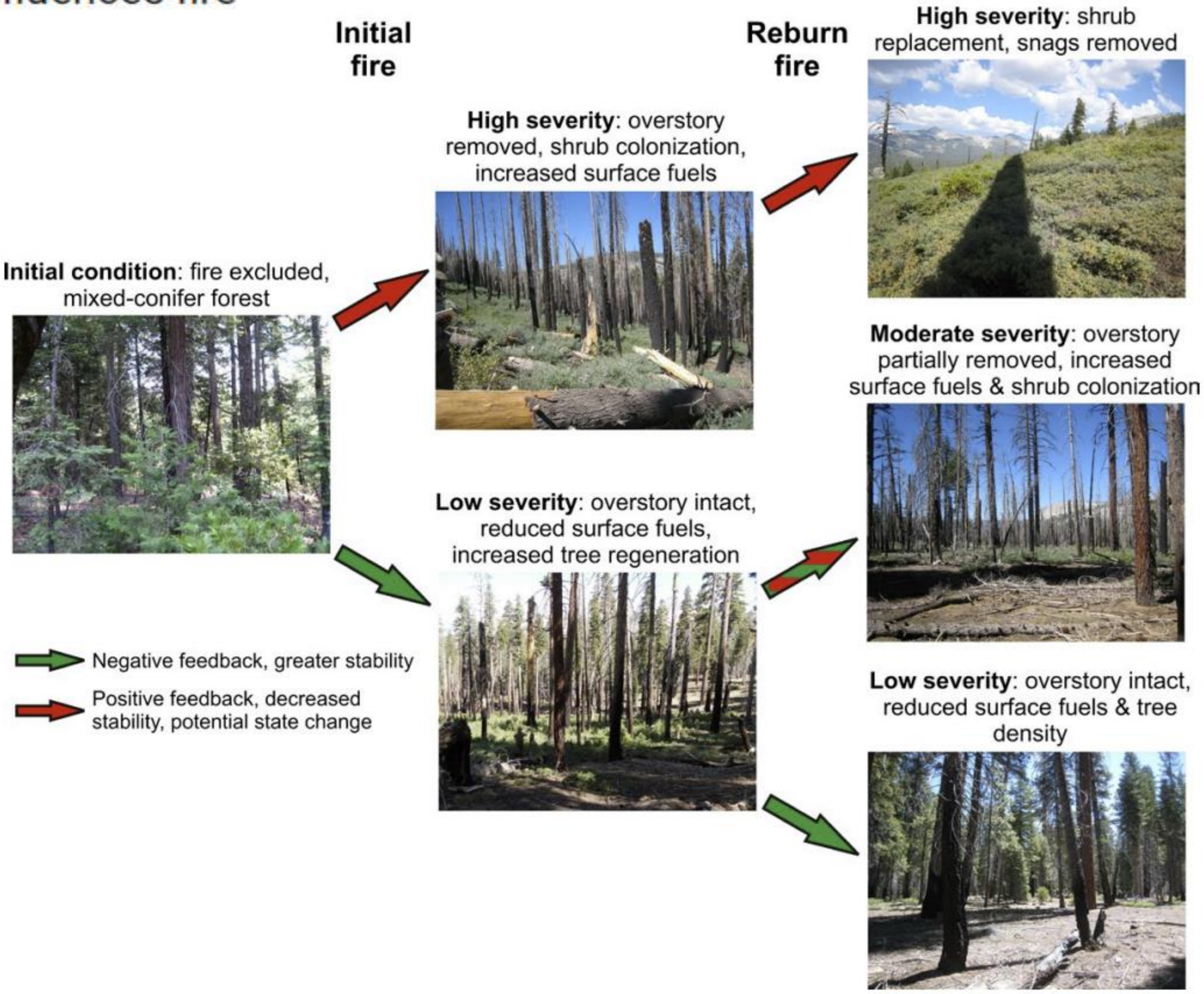


FIG. 1. Conceptual model of potential pathways for post-fire vegetation and fuel dynamics following initial fires and reburns. Time between initial fire and reburn is assumed to be relatively short (5–15 yr). Pathways are coded for the type of ecological feedback based on expected change to the dominant vegetation in response to different fire severity levels and effects these vegetation changes would have on subsequent fires.

- CONCLUSION-

Question 8:

Is the scale of the problem too great – can we ever catch up?

"...fuel treatments are unlikely to reduce fire severity and consequent impacts because often the treated area is not affected by fire before fuels return to normal levels."

BARK vs US Forest Service

Science-based adaptive management

We are currently not treating enough area with the many science-based adaptation strategies that have proven effective.

Increasing the pace and scale of adaptive management will require the use of many strategies including:

- Thinning and/or prescribed burning
- Support and revitalization of cultural burning
- Use of managed wildfires
- Pro-active post-fire planting and silviculture that enhance resilient structure and composition of forests
- Restoration of resilient patch mosaics

As with any adaptive management approach, science-based practices combined with active monitoring and adaptation are critical.

Climate change strategies

- RESIST – restore resilient structure and composition of western forests
- GUIDE – adapt forests to a warmer, often drier future
- ACCEPT – recognize that some transformations are inevitable

Wildfire-Driven Forest Conversion in Western North American Landscapes

JONATHAN D. COOP, SEAN A. PARKS, CAMILLE S. STEVENS-RUMANN, SHELLEY D. CRAUSBAY, PHILIP E. HIGUERA, MATTHEW D. HURTEAU, ALAN TEPLEY, ELLEN WHITMAN, TIMOTHY ASSAL, BRANDON M. COLLINS, KIMBERLEY T. DAVIS, SOLOMON DOBROWSKI, DONALD A. FALK, PAULA J. FORNWALT, PETER Z. FULÉ, BRIAN J. HARVEY, VAN R. KANE, CAITLIN E. LITTLEFIELD, ELLIS Q. MARGOLIS, MALCOLM NORTH, MARC-ANDRÉ PARISIEN, SUSAN PRICHARD, AND KYLE C. RODMAN

Changing disturbance regimes and climate can overcome forest ecosystem resilience. Following high-severity fire, forest recovery may be compromised by lack of tree seed sources, warmer and drier postfire climate, or short-interval reburning. A potential outcome of the loss of resilience is the conversion of the prefire forest to a different forest type or nonforest vegetation. Conversion implies major, extensive, and enduring changes in dominant species, life forms, or functions, with impacts on ecosystem services. In the present article, we synthesize a growing body of evidence of fire-driven conversion and our understanding of its causes across western North America. We assess our capacity to predict conversion and highlight important uncertainties. Increasing forest vulnerability to changing fire activity and climate compels shifts in management approaches, and we propose key themes for applied research coproduced by scientists and managers to support decision-making in an era when the prefire forest may not return.

Keywords: climate change, ecological transformation, high-severity fire, tree regeneration, tree seedlings, stand-replacing fire, wildfire, vegetation type conversion.

Additional Resources

Ecological Restoration Institute White Papers

<u>10 Common Questions</u>:

- https://cdm17192.contentdm.oclc.org/digital/collection/p17192coll1/id/1102/rec/7

<u>Evidence of departures</u>:

- https://cdm17192.contentdm.oclc.org/digital/collection/p17192coll1/id/1134/rec/5

<u>Sustainable Northwest StoryMap</u>:

- https://storymaps.arcgis.com/stories/64f55848f690452da6c58e5a888ff283